

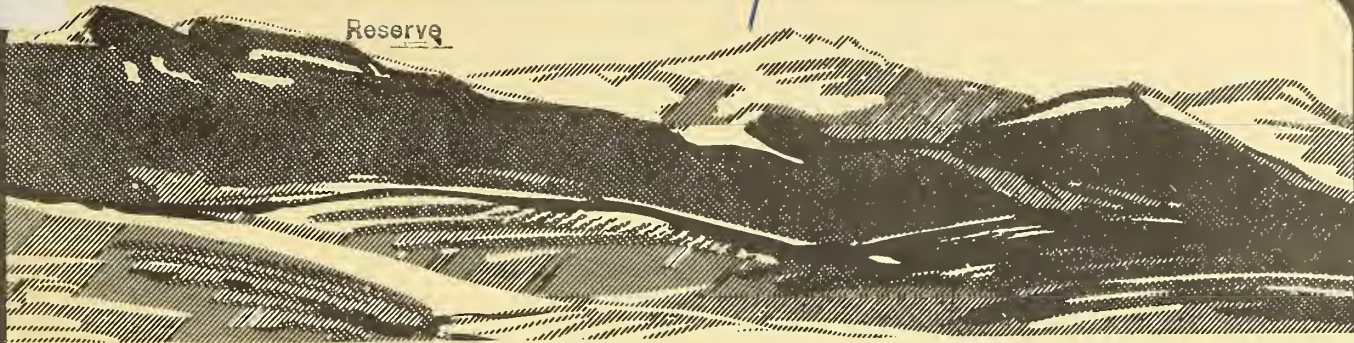
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Reserve



# RANGE IMPROVEMENT



## NOTES

NOVEMBER 1979

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U. S. DEPARTMENT OF AGRICULTURE  
FOREST SERVICE, INTERMOUNTAIN REGION  
OGDEN, UTAH

CURRENT SERIAL RECORDS

NOV 11 1979





PHOTO A

Typical Pinyon-Juniper type prior to treatment in the North Cedars area. Trees are primarily Juniper with some intermixed Pinyon. Understory is typically sparse to non-existent, depending on the density of the canopy:

General view of the North Cedars chained and seeded area. The location of the North Cedars Study Plot is the fenced plot partially shown on the left side of the picture. Picture is taken looking south with Mt. Belknap in the background. A good to excellent stand of grass is well established on this project.



PHOTO B

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NORTH CEDARS PINYON-JUNIPER STUDIES,  
1963-1977  
T. A. Phillips  
1978

### Introduction

The North Cedars Study was established in 1963 with major sampling efforts being made on the study area during 1963, 1968, and 1977.

The study area is located about 1 mile south of Clear Creek and 3 miles west of the Belknap Guard Station on the Fishlake National Forest in southern Utah. Elevation is about 6,500 feet and exposure is variable, but is generally to the east and south. Pretreatment vegetation on the study area was pinyon-juniper and scattered patches of mountain big sagebrush. Soils are of igneous origin, generally stony loams and are shallow on ridge tops and steeper slopes, and moderately deep to deep on the flats and in the drainage bottoms.

Precipitation maps indicate the study area is in the 12-16 inch zone. The records for Richfield, about 24 airline miles northeast and at 5,000 feet elevation, show 7.88 inches in 1963, 8.49 inches in 1968, and 5.95 inches in 1977. The 30-year average is 8.16 inches. These records indicate approximately one-third of the annual precipitation falls May through August. The winter of 1976-77 was extremely dry in southern Utah; in fact, one of the driest on record.

The study area is part of the Clear Creek Cattle Allotment. This allotment has an obligation of 473 cattle for a 6/11-9/30 season for 1,733 cow months. However, for the past several years, the permittees have been taking nonuse for 221 head; consequently, the current stocking is 251 head for 668 animal unit months. The area is also an important mule deer winter range. As with cattle, deer numbers have declined significantly during the past several years. The 251 head of cattle are grazed under a four-pasture rest-rotation grazing system with seedripeness, rest, flowering, and early grazing treatments.

### Study Procedure

A three-way enclosure was built as a means of comparing between no use, deer use, and cattle and deer use (PHOTO B). This consisted of a 10-acre cow-tight enclosure inside of which a one-acre deer-tight enclosure was constructed. Both of these are surrounded by range that is open to grazing by both deer and cattle. On each of these sites, stands of untreated pinyon-juniper were left to serve as controls. The remainder of the pinyon-juniper type was chained twice over and seeded to a grass-forb-shrub mixture containing the following species:

<u>Grasses</u>	<u>Forbs</u>	<u>Shrubs</u>
Smooth brome grass	Alfalfa	Four-wing saltbush
Crested wheatgrass		Bitterbrush
Pubescent wheatgrass		Cliffrose
Intermediate wheatgrass		
Indian ricegrass		
Sand dropseed		
Hard fescue		

✓ Thomas A. Phillips, Zone Range Conservationist, Sawtooth National Forest, now retired.



Seed was broadcast before the second chaining at a rate of 10 pounds per acre. In addition, four-wing saltbush, cliffrose, and bitterbrush were seeded in short rows on eight sites that were scattered throughout the study area.

Region 4 site analysis transects were used in sampling the various treated and control areas. Data obtained from the transects were vegetative production (air dry), ground cover, species, and other site information. In addition, 30 photo points were established on the area to indicate changes that occurred in vegetation and ground cover through the years.

## Results

### Herbage Production - Unchained Control Areas

There are three unchained control areas (PHOTO B). These unchained control areas are: (1) Outside the enclosure - on the area open to grazing; (2) Inside the cattle enclosure and (3) Within the deer-tight enclosure.

Understory production on all unchained control areas ranged from 20 to 77 pounds per acre, air dry weight and averaged 42 pounds during the study period (Table 1). Production was greatest in 1968, when it averaged 73 pounds per acre. This is probably because 1968 was a wetter than normal year, with precipitation exceeding 1963 by 8 percent and 1977 by 43 percent.

Table 1  
Vegetative Production - Pounds per Acre  
Unchained Control Areas

Location	1963 Production (lbs./acre)				1968 Production (lbs./acre)				1977 Production (lbs./acre)			
	Grass	Forbs	Shrubs	Total	Grass	Forbs	Shrubs	Total	Grass	Forbs	Shrubs	Total
Outside Enclosure	14	6	0	20	60	5	12	77	30	3	4	37
Inside Enclosure	10	10	0	20	60	9	0	69	25	6	0	31
Deer-Tight Enclosure	2	18	12	32	-	-	-	-	36	14	2	52

Grasses comprised 70 percent of the total understory production on the unchained control areas, while the forb and shrub components contributed 21 percent and 9 percent respectively. Five grasses, 14 forbs, and 2 shrub species occurred on the transects (Table 2). Bottlebrush squirreltail was the most common grass. It occurred on 28 percent of all microplots and comprised 38 percent of the total herbage produced. Mutton bluegrass and Indian ricegrass ranked second and third in grass production respectively. The dominant forb was Hoods phlox. It occurred on 28 percent of the microplots and produced 5 percent of the total understory herbage. Shrubs were extremely sparse on the unchained control areas, with low rabbitbrush occurring on 3 percent of the plots, and mountain big sagebrush occurring on 1 percent of the plots. The former contributed 4 percent of the total understory production, while the latter contributed 1 percent.

Table 2  
North Cedars Pinyon-Juniper Study  
Frequency and Species Composition on Unchained Control Areas  
1977 Transects

<u>SPECIES</u>	<u>% FREQUENCY 1/</u>	<u>% COMPOSITION 2/</u>
<u>Grass</u>		
Sitanion hystrix	28	38
Poa fendleriana	17	16
Oryzopsis hymenoides	10	13
Festuca ovina	1	5
Carex rossii	1	5
<u>Forbs</u>		
Phlox hoodii	28	5
Trifolium spp.	6	T
Cryptantha spp.	4	2
Eriogonum racemosum	3	4
Astragalus spp.	3	1
Commandra pallida	1	1
Castilleja spp.	1	2
Penstemon spp.	1	1
Unknown	1	1
Senecio uintahensis	1	1
Arabis spp.	1	1
Polygonum aviculare	1	1
Chaenactis douglasii	1	1
Phacelia spp.	T	1
<u>Shrubs</u>		
Chrysothamnus viscidiflorus	3	4
Artemisia tridentata vaseyana	1	1

1/ Frequency = The percentage of the total microplots upon which the species occurred.

2/ Composition = The percentage of the total air dry understory production contributed by the species.

Photographs of the unchained control areas indicate a definite increase in vigor of the grasses and shrubs in the cow-tight and deer-tight enclosures but not in the control area open to grazing. The increased vigor is indicated by larger, more robust plants and more open growth form. There was no evidence of new shrubs becoming established in the unchained control areas, but Blue grama had spread to some extent.

### Ground Cover - Unchained Control Areas

Ground cover provided by vegetation and litter on the unchained control areas ranged from 23 to 54 percent and averaged 38 percent (Table 3). During the 14-year study period, there was a decline in ground cover on two unchained control areas regardless of whether those areas were protected or grazed. The decline ranged from 17 percent in the open areas to 14 percent in the deer-tight enclosure.

Table 3  
Ground Cover Percentages  
Unchained Control Areas

Location	1963			1968			1977		
	Cover Percentage			Cover Percentage			Cover Percentage		
	Bare Ground	Rock & Pavement	Veg. & Litter	Bare Ground	Rock & Pavement	Veg. & Litter	Bare Ground	Rock & Pavement	Veg. & Litter
Outside Enclosure	33	20	47	33	29	38	33	37	30
Cow-Tight Enclosure	26	31	43	30	47	23	15	36	49
Deer-Tight Enclosure	32	14	54	-	-	-	37	23	40

### Herbage Production - Chained and Seeded Areas

The major characteristic of the chained areas was the large increase in production and ground cover (vegetation and litter) that resulted from chaining and seeding. Compared to control areas, production increases, as measured in 1968 and 1977, ranged from a low of 356 pounds per acre increase in 1977 to a high of 1,521 pounds per acre increase in 1968 (Table 4). The chained area in the cow-tight enclosure proved to be the most productive. The chained area in the deer-tight enclosure ranked second, followed closely by the chained area open to grazing by both deer and livestock during the 14-year period. On the chained areas, pretreatment production averaged 24 pounds per acre in 1963. This increased to an average of 1,049 pounds by 1968 and then declined to 408 pounds in 1977. The decline was undoubtedly due to 43 percent less precipitation in 1977, than in 1968: The 1968 precipitation was only 7 percent greater than in 1963.

The highest production of all was on a narrow strip of land near the northwest corner of the cow-tight enclosure which was chained, ripped, and cleared of all pinyon-juniper trees, then seeded. In 1968, this strip produced about a ton of herbage per acre. Production has declined through the years, but the strip has still retained its superior productivity. For example, in 1977, the chained, ripped, and seeded strip, inside the cow-tight enclosure, produced 880 pounds per acre compared to 387 pounds on adjacent treated areas inside the enclosure. In the open area production was 639 pounds per acre on the chained, seeded, and ripped strip compared to 356 pounds on contiguous treated areas.

Chaining and seeding resulted in a large gain in grass production, but little or no gain in forb and shrub production. In 1968, grass produced 97 percent of the total herbage, but by 1977, this had declined to 79 percent. There was little change in forb production during the 10-year period, but the shrub component increased from 2 percent in 1968 to 18 percent in 1977.



Table 4  
Vegetative Production - Pounds per Acre  
Treated Areas (Chained and Seeded)

Location	1968 Production (lbs./acre)				1977 Production (lbs./acre)			
	Grass	Shrubs	Forbs	Total	Grass	Shrubs	Forbs	Total
Outside Exclosure								
Control	60	5	12	77	30	3	4	37
Treated	750	30	0	780	355	11	27	393
+ or - Difference	+690	+25	-12	+703	+325	+8	+23	+356
Inside Cow-Tight Exclosure								
Control	60	9	0	69	25	6	0	31
Treated	1590	T	0	1590	396	18	4	418
+ or - Difference	+1530	-9	0	+1521	+371	+12	+4	+387
Inside Deer-Tight Exclosure								
Control	-	-	-	-	36	14	2	52
Treated	714	6	57	777	219	4	189	412
+ or - Difference	-	-	-	-	+183	-10	+187	+360

Ten grasses, 9 forbs, and 3 shrub species were noted on the transects in 1977 (Table 5). Four introduced grasses--intermediate, crested, and pubescent wheatgrass, plus hard fescue produced about 80 percent of the total herbage. Intermediate and crested wheatgrass were the most common species and the heaviest producers. They occurred on 53 and 50 percent of the microplots, respectively, and produced 30 and 25 percent of the total herbage. Each of the four introduced grasses occurred on more than 15 percent of the microplots and accounted for 10 percent or more of the total production. Six native grasses were found on the chained and seeded sites, but they produced little, if any, more herbage than did the same species on the control areas.

Table 5  
North Cedars Pinyon-Juniper Study  
Frequencies and Species Composition on Chained and Seeded Areas

<u>Chained and Seeded Areas</u>		
<u>SPECIES</u>	<u>% FREQUENCY 1/</u>	<u>% COMPOSITION 2/</u>
<u>Grass</u>		
Agropyron intermedium	53	30
Agropyron cristatum	50	25
Festuca ovina	31	15
Agropyron trichophorum	17	9
Carex rossii	3	T
Oryzopsis hymenoides	2	T
Poa fendleriana	2	T
Sitanion hystrix	1	T
Bouteloua gracilis	1	T
Bromus tectorum	1	T
<u>Forbs</u>		
Phlox hoodii	5	1
Astragalus ssp.	4	T
Cryptantha ssp.	3	T
Eriogonum racemosum	2	T
Erigeron bloomeri	2	T
Sphaeralcea coccinea	1	1
Senecio uintahensis	1	T
Antennaria microphylla	1	T
Unknown	1	T
<u>Shrubs</u>		
Chrysothamnus viscidiflorus	8	6
Artemisia tridentata vaseyana	7	10
Purshia tridentata	1	3

1/ Frequency = The percentage of the total microplots upon which the species occurred.

2/ Composition = The percentage of the total understory production contributed by the species.

The 9 forb species were also poor producers. Hoods phlox was the dominant forb, but it occurred on only 5 percent of the microplots and only produced 1 percent of the herbage. All other forbs appeared on less than 5 percent of the microplots and produced less than 1 percent of the herbage.

Alfalfa was the only introduced forb species included in the seeding mixture. This plant occurred in a very sparse stand and is currently contributing little to the forage resource on the study area. Photographs show it was growing well under utilization cages in 1968 and 1973, but it appeared to be declining in 1977. It was not abundant in the deer-tight enclosure where deer or cattle have not grazed for the past 14 years.

Three browse species--Douglas rabbitbrush, mountain big sagebrush, and bitterbrush occurred on the microplots on the chained and seeded area. Other browse species such as birchleaf mountain mahogany, occur in this area, but were not found in any of the microplots. Like the native grasses and forbs, the three browse species noted above were relatively poor producers. Together, the three species produced about 20 percent of the total herbage, but they all occurred on less than 10 percent of the microplots. The production shown by shrubs is misleading, since most of it was concentrated in the chained area inside the deer-tight enclosure. Photographs taken in this enclosure indicate the chained and seeded area was in an open stand of pinyon-juniper supporting a relatively dense shrub understory of sagebrush and bitterbrush. Mortality of shrubs on the treated areas was light. Consequently, a much better than normal shrub stand established on the area. Shrub production on the chained and seeded areas amounted to 377 pounds per acre in the deer-tight enclosure in 1977. By comparison, it was 54 pounds per acre in the open area and only 4 pounds per acre in the cow-tight enclosure.

The 1963 row plantings of four-wing saltbush, bitterbrush, and cliffrose must be considered a failure, regardless of whether they were in the deer-tight, cow-tight, or open areas. A few bitterbrush and four-wing saltbush plants were noted, but no cliffrose plants were found. Four-wing saltbush plants protected by utilization cages showed good vigor and are apparently able to compete with the grass species. However, this does not explain why these plants could not compete in the deer-tight enclosure where deer or cattle have not grazed since 1963. It may be that the young plants were killed by rabbits.

Poor shrub and forb stands on chained and seeded pinyon-juniper projects in Utah are common (see Range Improvement Notes, September Issue, 1977). Poor stands apparently result from over use by grazing animals such as cattle, deer, rabbits, and rodents. It could also be caused by severe competition from grasses. A contributing factor may be that not enough forb and browse seed is included in the seeding mixture to establish a viable stand.



### Ground Cover - Chained and Seeded Areas

All chained and seeded areas showed significant gains in ground cover provided by vegetation and litter when compared to the control areas. Differences between control and treated (chained and seeded) areas in 1977 were as follows:

Area	Control %	Treated %	Difference	Increase %
Open	30	61	+31	103
Cow-tight	49	71	+22	45
Deer-tight	40	67	+27	68
Average . . . .	40	66	+27	72

While the area open to grazing by cattle and mule deer showed the greatest percentage increase in cover, it supported 6 to 10 percent less ground cover than the cow-tight and deer-tight exclosures. This indicates the effects of the heavier grazing on the open area. It also indicates that grazing during the 14-year study period did not prevent a build-up in ground cover. See Table 6. This increase in vegetation and litter has helped tie down the soil and is preventing most of the accelerated erosion. This has improved watershed and hydrologic characteristics of the chained and seeded areas.

Table 6  
Ground Cover Percentages  
Treated Areas (Chained and Reseeded)

Location	1963 Cover Percentage			1968 Cover Percentage			1977 Cover Percentage		
	Bare Ground	Rock & Pavement	Vegetation & Litter	Bare Ground	Rock & Pavement	Vegetation & Litter	Bare Ground	Rock & Pavement	Vegetation & Litter
Outside Exclosure									
Control	33	20	47	33	29	38	33	37	30
Chained and Seeded				4	18	78	25	14	61
+ or - Difference				-29	-11	+40	-8	-23	+31
Inside Cow-Tight Exclosure									
Control	26	31	43	30	47	23	15	36	49
Chained and Seeded				5	6	89	25	4	71
+ or - Difference				-25	-41	+66	+10	-32	+22
Inside Deer-Tight Exclosure									
Control	32	14	54	19	4	77	37	23	40
Treated				-	-	-	24	9	67
+ or - Difference				-	-	-	-13	-14	+27

The vegetation and litter components of the ground cover on the chained and seeded areas have increased to the following percentages:

- (1) Area open to grazing by cattle and deer      61%
- (2) Cow-tight exclosure                              71%
- (3) Deer-tight exclosure                              67%

## Pinyon-Juniper and Shrub Stand Density

In 1977, pinyon-juniper, sagebrush, and bitterbrush plants were counted on several 100-square foot plots to obtain some indication of stand density of these species on treated and control areas.

Bitterbrush averaged 130 plants per acre on the control areas compared to 84 plants per acre on the chained and seeded areas. This indicates that bitterbrush mortality occurred as a result of the chaining. The best bitterbrush density occurred on the chained and seeded area in the deer-tight enclosure with 174 plants per acre (Table 7). Bitterbrush plants on all areas open to grazing by deer and cattle showed hedging and were generally low in stature, thus indicating heavy grazing use. Those plants in the deer-tight and cow-tight enclosures were showing relief from hedging and a more open growth form. However, plants in the unchained control areas will never reach a large size and most will eventually be eliminated by the pinyon-juniper competition.

Table 7  
North Cedars Pinyon-Juniper Study  
Pinyon-Juniper, Sagebrush, and Bitterbrush Stand Density

SPECIES	PLANTS PER ACRE				MORTALITY %
	COW-TIGHT	DEER-TIGHT	OPEN	AVERAGE	
Bitterbrush					
Control	130	131	130	130	
Treated	29	174	48	84	
+ or - Difference	-101	+43	-82	-46	35
Sagebrush					
Control	73	1,089	22	394	
Treated	87	566	276	309	
+ or - Difference	+14	-523	+254	-85	22
Pinyon-Juniper					
Control	857	631	479	656	
Treated	87	871	330	429	
+ or - Difference	-770	+240	-149	-227	35

Sagebrush was very sparse on the cow-tight and open to grazing portions of the unchained control areas, averaging only 73 and 22 plants per acre, respectively. On the other hand, there were 1,089 sagebrush plants per acre under the pinyon-juniper stand in the deer-tight enclosure control area, while the chained and seeded area in the deer-tight enclosure supported a sagebrush density of 566 plants per acre. There was a significant increase in sagebrush on the open area, 276 plants per acre on the chained and seeded area compared to 22 plants per acre on the control area. The average for all sites was 394 sagebrush plants per acre on the untreated control areas, compared to 309 plants per acre on the chained and seeded areas.

Pinyon-juniper stands ranged from 87 trees per acre on the cow-tight chained and seeded area to 871 trees per acre on the deer-tight control area. There was an average of 656 trees per acre on the control areas and 429 on the chained and seeded areas. Trees on the chained and seeded areas were mostly those that had survived the chaining, rather than trees which had grown from seed since the chaining. Trees were mostly 2 to 4 feet tall and were showing good vigor. Photos indicate that one of the major changes in the chained and seeded areas is the rapid growth of the surviving pinyon-juniper trees. The ripped strips are about the only places on the study area that do not support at least some young pinyon-juniper trees.

When all chained and seeded areas are compared to the control areas, the indicated stand reduction as of 1977 is as follows:

	Number of Plants Per Acre		
	<u>Bitterbrush</u>	<u>Sagebrush</u>	<u>Pinyon-Juniper</u>
Control	130	394	656
Treated	<u>84</u>	<u>309</u>	<u>429</u>
Difference	-46	-85	-227
Percent Reduction	35%	22%	35%

Fourteen years after treatment, it is evident that stand density of these species on the chained and seeded areas is still significantly less than on the control areas. However, both sagebrush and pinyon-juniper are well established on the chained and seeded areas. Both can be expected to increase dominance until pinyon-juniper gains control of the sites, at which time sagebrush will decline. Understory generally begins to decline when pinyon-juniper overstory reaches about 20 percent crown coverage. On this area, coverage probably will not be reached for another 20 to 30 years.

#### Utilization

Utilization measurements were made on the area open to grazing by deer and cattle in 1964 and 1977. These measurements show that summer grazing by cattle was almost entirely confined to the introduced grass species. The native grasses on the open to grazing control areas showed practically no use, while these species showed moderate use on the chained and seeded areas. Utilization on the four species in the stand producing the most forage and showing the heaviest use was as follows:

<u>Species</u>	<u>Utilization %</u>	
	<u>1964</u>	<u>1977</u>
Crested wheatgrass	78	68
Pubescent wheatgrass	80	60
Intermediate wheatgrass	81	46
Hard fescue	0	15



Native species such as Blue grama, Mutton bluegrass, Indian ricegrass, Ross sedge, and Bottlebrush squirreltail produced an average of about 5 pounds per acre. Seventy percent utilization of Indian ricegrass was the heaviest use. On the others, use averaged about 30 percent. None of the browse species showed more than a trace of utilization. However, fall grazing by cattle would result in utilization on bitterbrush, and winter grazing by deer would result in significant use on bitterbrush and sagebrush.

Under the four-pasture rest-rotation grazing system in effect on the allotment, bitterbrush is relatively ungrazed by cattle 2 years out of each 4-year rotation (during the rest and the early grazing treatments) and is grazed regularly by cattle the other 2 years of the rotation (flowering and seed ripe treatments).

The wide difference in use between 1964 and 1977 is explained by the fact that more cattle were using the Clear Creek allotment in 1964. Further, the chained area around the cow-tight enclosure has been greatly expanded since 1964. This has resulted in better cattle distribution and fewer cattle congregating around the cow-tight enclosure.

Pellet group transects were run in November 1963. These showed 26 deer days use per acre in the cow-tight enclosure and 18 deer days use per acre in the treated area outside the enclosure. In May of 1977, pellet group counts in the vicinity of the cow-tight enclosure in the open area indicated 26 deer days use per acre.

Table 8

## Species List

<u>Scientific Name</u>	<u>Common Name</u>
<u>Grass - Grasslike</u>	
Agropyron cristatum	Crested wheatgrass
" intermedium	Intermediate wheatgrass
" trichophorum	Pubescent wheatgrass
Bouteloua gracilis	Blue grama
Bromus inermis	Smooth brome
" tectorum	Cheatgrass
Carex rossii	Ross sedge
Festuca ovina duriuscula	Hard fescue
Oryzopsis hymenoides	Indian ricegrass
Poa fendleriana	Mutton bluegrass
Sitanion hystrix	Bottlebrush squirreltail
Sporobolus cryptandrus	Sand dropseed
<u>Forbs</u>	
Antennaria microphylla	Pussytoes
Arabis spp.	Rockcress
Astragalus spp.	Locoweed
Castilleja spp.	Indian paintbrush
Chaenactis douglassii	Douglas chaenactis
Commandra pallida	Bastard toadflax
Cryptantha spp.	Cryptantha
Erigeron bloomeri	Bloomer fleabane
Eriogonum racemosum	Redroot eriogonum
Medicago sativa	Alfalfa
Penstemon spp.	Penstemon
Phacelia spp.	Phacelia
Phlox hoodii	Hoods phlox
Polygonum aviculare	Prostrate polygonum
Senecio uintahensis	Groundsel
Sphaeralcea coccinea	Scarlet globemallow
Trifolium spp.	Clover
<u>Trees and Shrubs</u>	
Artemisia tridentata vaseyana	Mountain big sagebrush
Atriplex canescens	Four-wing saltbush
Cercocarpus montanus	True mountain mahogany
Chrysothamnus nauseosus douglassii	Douglas rabbitbrush
Chrysothamnus viscidiflorus	Low rabbitbrush
Cowania mexicana stansburiana	Cliffrose
Juniperus osteosperma	Utah juniper
Pinus edulis	Pinyon
Purshia tridentata	Antelope bitterbrush

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METAL CIRCULAR TROUGH (BY-PASS TYPE) [ 3  
Submitted by Norm Huntsman, Humboldt N.F.

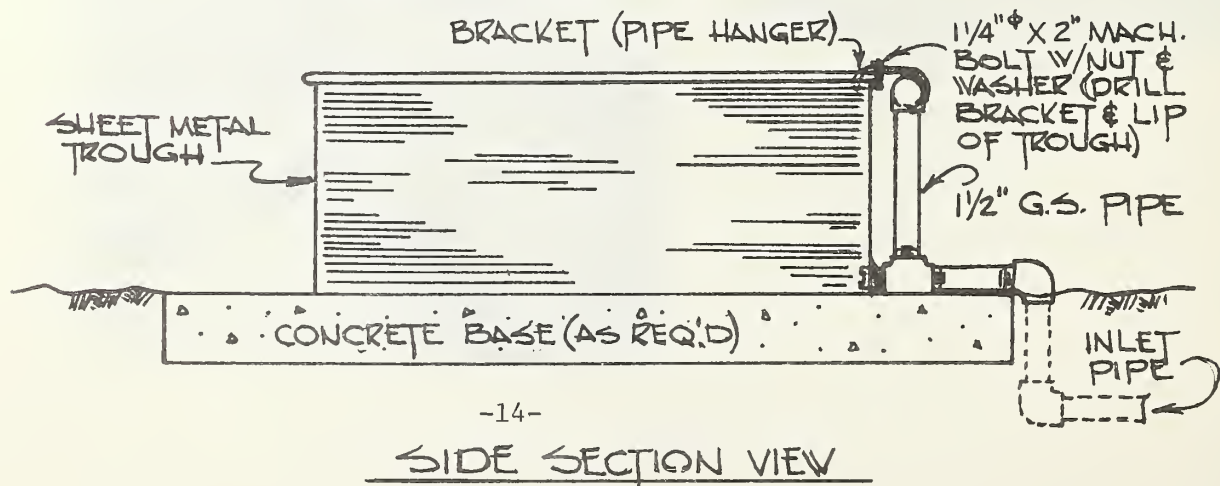
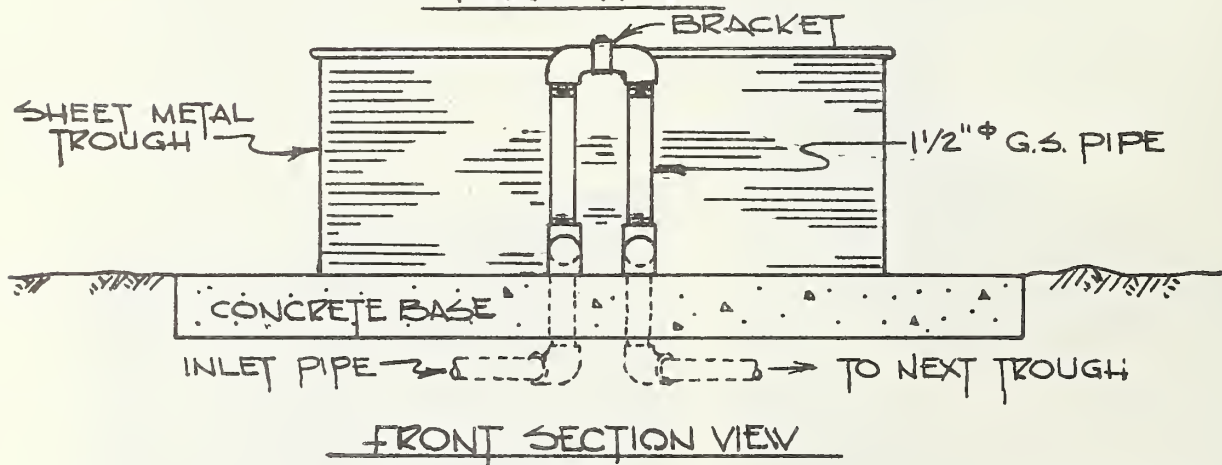
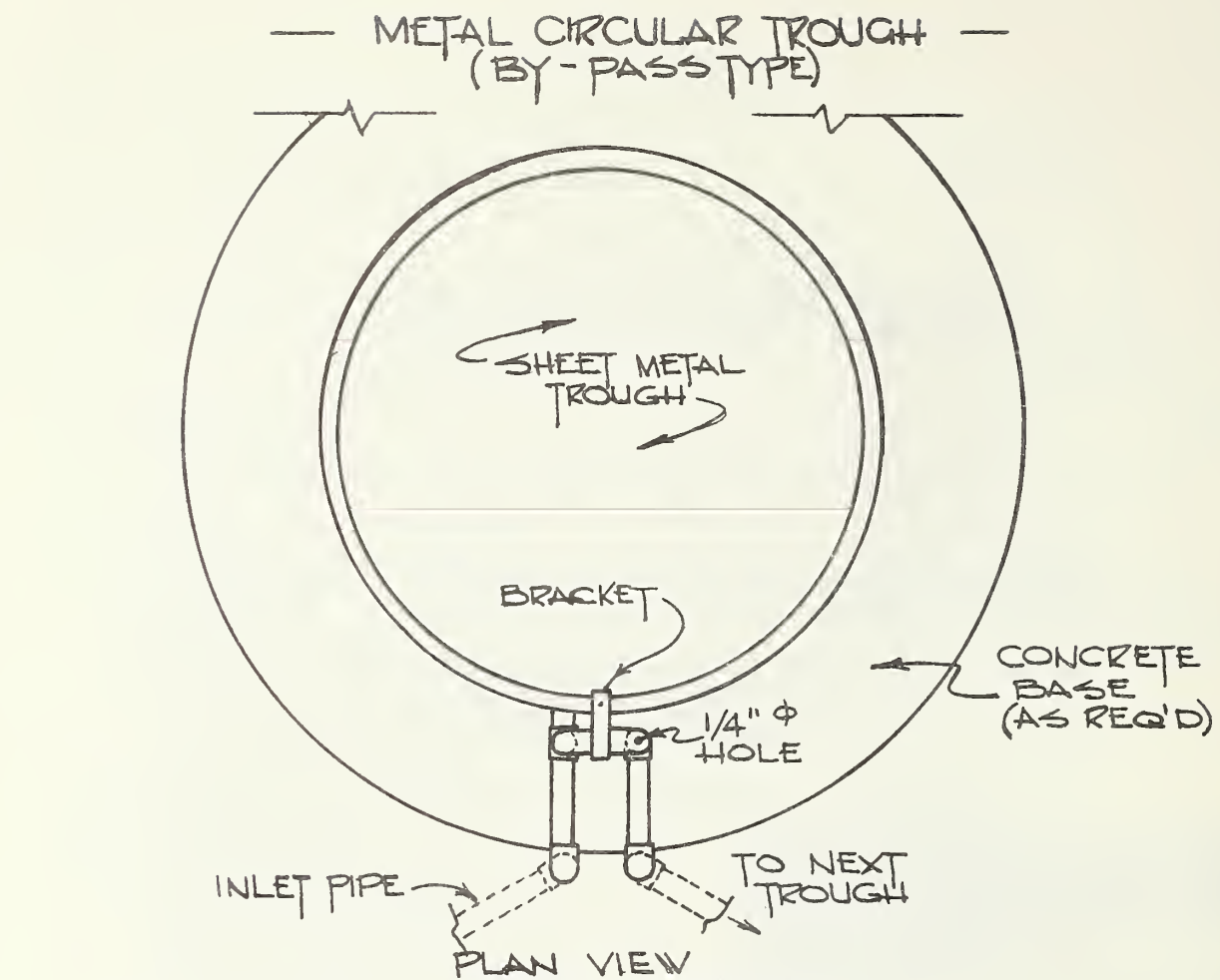
Notes:

1. The low point of the inlet line should have some means of being drained.
2. Top of [piping] (near top of trough) should be at elevation desired for maximum level of water in trough.
3. To prevent the trough from continually overflowing, the system must be designed such that the flow capacity of the outlet line is equal to or greater than the flow of the inlet line.

See Plan R4-RM31 in FSM 2209.22.







## S T A T E M E N T   O F   P U R P O S E

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This publication is printed primarily to inform professional range administrators of important range improvement and management developments and findings. These "NOTES" may include extracts of published papers, unpublished preliminary reports of research work, unpublished reports on administrative studies and personal observations or suggestions of other range administrators. No claim is made as to the accuracy or completeness of studies or conclusions drawn.

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